ROTARY PROCESSING DEVICE

FIELD OF THE INVENTION

The present invention relates to a rotary processing device and more particularly to a rotary food processing device that is capable of processing food related waste.

BACKGROUND OF THE INVENTION

In the past, conventional rotary processing devices utilized a frame from which components of the device were hung. These components included end plates, one or more sidewalls and the like. In addition, rotary components of the device are typically supported by trunnions, which are also mounted to the frame. While these devices have been commercially successful, improvements nonetheless remain.

What is needed is a rotary processing device made with a minimum of components.

SUMMARY OF THE INVENTION

The invention is directed to a rotary product processing device which is used to process product, such as food product, waste product, and the like, using a rotary action while the product is disposed in a product processing chamber. The device includes a frame, an inlet, an outlet, a product processing chamber in which product is processed, and a drive. The drive can be coupled to an auger that is disposed inside the product processing chamber. The auger can be engaged with the product processing chamber

such that rotating the product processing chamber also rotates the auger. Where such engagement exists, rotation of the auger and product processing chamber occur substantially in unison therewith.

In a preferred embodiment, the frame is made up of a pair of end plates of one piece and unitary construction that are spaced apart by a sidewall that also is of one piece and unitary construction. The sidewall has a pair of side edges that are each preferably equipped with a pair of outwardly extending locator tabs that each are received in a complimentary locator slot in one of the end plates. In one preferred embodiment, each locator tab and its corresponding slot extend in a diagonal direction for providing both horizontal and vertical end plate and sidewall location during assembly.

In a preferred embodiment, there also is a hood that overlies the product processing chamber that is of one piece and unitary construction that also is equipped with integrally formed handles. In a preferred embodiment, the sidewall extends underneath the product processing chamber to form a fluid-holding tank therealong.

In a preferred embodiment, the drive is mounted to one of the end plates. Preferably, the drive is mounted to the inlet end plate and can be oriented such that it overlaps or overlies the product processing chamber. The drive preferably is coupled by a drive arrangement that is also mounted or otherwise carried by the same end plate as what carries the drive. A cover preferably mates with the end plate thereby helping to form a drive assembly enclosure therebetween that encompasses the drive arrangement.

In a preferred embodiment, there is a bearing cradle at each end that rotatively supports one end of the auger or the product processing chamber. Each bearing preferably is of one piece, unitary, non-metallic and homogenous construction. In one preferred embodiment, one bearing cradle is of two piece construction, forming an annular bearing cradle, and the other bearing cradle is annular in shape. Where such is the case, each bearing cradle component, excluding any mounting hardware, is of one piece, unitary, non-metallic and homogenous construction. In one preferred embodiment, at least one of the bearing cradles functions as both a rotary bearing and a thrust bearing.

Other objects, features, and advantages of the present invention will become apparent to those skilled in the art from the detailed description and the accompanying drawings. It should be understood, however, that the detailed description and accompanying drawings, while indicating at least one preferred embodiment of the present invention, are given by way of illustration and not of limitation. Many changes and modifications may be made within the scope of the present invention without departing from the spirit thereof, and the invention is intended to include all such modifications.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred exemplary embodiments of the invention are illustrated in the accompanying drawings in which like reference numerals represent like parts throughout and in which:

Fig. 1 is a rear perspective view of a preferred embodiment of a rotary product processing device made in accordance with the invention ;

Fig. 2 is an exploded view of the rotary product processing device of FIG. 1;

Fig. 3 is front perspective view of the rotary product processing device;

Fig. 4 is a fragmentary front perspective view of the rotary product processing device of the invention with a cover and parts of a drive assembly removed for clarity;

Fig. 5 is a fragmentary front perspective view of the rotary product processing device of the invention with a cover removed to show parts of a drive assembly and a hood removed to show a product processing chamber and conduit;

Fig. 6 is a cross-sectional view of the rotary product processing device;

Fig. 7 is an enlarged cross sectional view of the inlet end of the rotary product processing device;

Fig. 8 is an enlarged cross sectional view of the outlet end of the rotary product processing device;

Fig. 9 is a front view of a preferred embodiment of an inlet end bearing cradle;

Fig. 10 is an end view of the inlet end bearing cradle;

Fig. 11 is a cross section of the inlet end bearing cradle taken along line 11—11 of Fig. 9;

Fig. 12 is a front view of a preferred embodiment of an outlet end bearing cradle;

Fig. 13 is an cross sectional view of the outlet end bearing cradle taken along line 13—13 of Fig 12; and

Fig. 14 is an enlarged cross sectional view of the outlet end bearing cradle taken along line 14—14 of Fig. 12.

Before explaining one or more embodiments invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments or being practiced or carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein is for the purpose of description and should not be regarded as limiting.

DETAILED DESCRIPTION

Figs. 1-3 illustrate a rotary processing device 30 of the invention that includes a frame 32, a product conveying arrangement 34, and a drive assembly 36 coupled to the product conveying arrangement 34. Referring additionally to Fig. 2, the product conveying arrangement 34 is supported adjacent an inlet 38 by a bearing arrangement 40 and is supported adjacent an outlet 42 by another bearing arrangement 44. During operation, product to be processed enters the inlet 38, is processed while being moved along by the product conveying arrangement 34, and is expelled out the outlet 42.

The frame 32 includes an outlet end plate 46 to which at least one longitudinally extending sidewall arrangement 48 is anchored. The frame 32 also includes an inlet end plate 50 to which the at least one longitudinally extending sidewall arrangement 48 is also

anchored. In the preferred embodiment shown in the drawing figures, the sidewall arrangement 48 is made up of a pair of sidewalls 52, 54 with each one of the sidewalls attached at its outlet end to the outlet end plate 46 and attached at its inlet end to the inlet end plate 50.

The outlet end plate 46 is of one-piece unitary and homogenous construction. In a preferred embodiment, the end plate 46 is cut from a sheet of stainless steel to a tolerance of about five thousandths of an inch using a cutting machine that preferably is a laser cutting machine. The outlet end plate 46 preferably rests directly upon the ground or upon a spacer or locator block (not shown) that is grounded. The end plate 46 has a generally planar section 56 and a pair of tabs 58, 60 that each serve as a foot for the rotary processing device. The pair of tabs 58, 60 is formed from the cut sheet such that they are integrally formed. As is shown in more detail in Fig. 2, the end plate 46 has a relatively large circular bore 62 through which a journal 64 of the rotary processing chamber 34 extends and a notch or bore 66 through which a conduit 68 is received.

Referring additionally to Fig. 4, the inlet end plate 50 is also of one-piece unitary and homogenous construction. The end plate 50 preferably is cut from a sheet of stainless steel such that a plurality of pairs of sidewall forming flanges 70 are formed along with a plurality of pairs of mounting arms 72 that is each carried by a flange 70. The end plate 50 has a generally planar section 74 with a drive-carrying arm 76 that positions the drive assembly 36 such that it overlies a portion of the rotary processing chamber 34. Each bent flange 70 forms an outturned sidewall 80 about the periphery of

the generally planar section 74 of the end plate 50, which increases end plate stiffness, structural rigidity and strength. Another pair of outturned integral flanges 82, 84 function as a pair of feet for the rotary processing device 30.

When each flange 70 is desirably bent in the manner depicted, it forms part of the drive assembly enclosure 78 shown in Figs. 3 and 4. As is shown in Fig. 3, a cover 71 mates with the end plate 50 to complete the drive assembly enclosure 78. A plurality of fasteners 73 are used to attach the cover to the end plate 50. For example, each fastener 73 extends through a bore in the cover (not shown) and engages one of the mounting arms 72 to attach the cover 71 to the end plate 50. The cover 71 also includes an inlet conduit 75 that communicates matter to be processed to the inlet 38 of the processing chamber 34.

Referring once again to Fig. 2, to accommodate a shaft 86 of the drive assembly 36, the arm 76 of the planar section 74 of the inlet end plate 50 has a bore 88 in it through which a portion of the shaft 86 extends. To accommodate a journal 90 of the inlet end of the rotary processing chamber 34, the planar section 74 below the arm 76 has a second bore 92 through it.

The frame 32 is formed with a minimum of components thereby advantageously simplifying assembly, maintenance and expenses associated therewith. The frame 32 is formed by attaching the sidewall arrangement 48 to the end plates 46, 50 by bonding them together. One preferred bonding method is welding. When assembly is completed,

the resultant frame 32 is strong, stiff, and structurally rigid enough to meet the continuous operational demands of rotary processing device operation.

To facilitate assembly, each end plate 46, 50 has a plurality of pairs of diagonally extending slots 94, 96 that each receive a corresponding lug 98, 100 that extends outwardly from a side edge 102, 104 of each sidewall panel 52, 54. For example, each side edge 102 and 104 of each sidewall panel 52, 54 has an upper lug 98 and a lower lug 100 that each extends outwardly from the side edge. During assembly, each end plate 46, 50 is vertically oriented and at least one of the sidewall panels 52, 54 is generally horizontally oriented with its upper lug 98 disposed adjacent an upper end plate slot 94 and its lower lug 100 disposed adjacent a lower end plate slot 96. The end plates 46, 50 are brought toward the sidewall panel such that each lug 98, 100 is received in its corresponding slot 94, 96. The same is done with the other sidewall panel.

The end result is a frame assembly 32 that is self-aligning, substantially self-supporting, and which helps form its own fixture. As a result, attachment of the frame components is simpler and easier because, once the lugs are seated in their respective slots, a fabricator only needs to make sure that each end plate 46, 50 is firmly abutted against the adjacent side edge of each sidewall panel 52, 54 before attaching the components together. For example, after assembly and making sure each end plate is firmly abutted against the adjacent side edge of each sidewall panel, each end plate is bonded, preferably by welding, to each adjacent sidewall panel, preferably along its side edge.

Figs. 2-4 illustrate a drive assembly 36 of the invention in more detail. The drive assembly 36 includes a drive 106 that is mounted by a coupling arm 108 to a gearbox 110 that is fixed to the arm section 76 of the end plate 50. The gearbox shaft 86 extends through a bore 88 (Fig. 2) in the end plate 50 where it receives a drive wheel 112 of a drive arrangement 114. An endless flexible member 116 connects the drive wheel 112 to a driven wheel 118 for rotation substantially in unison therewith. The driven wheel 118 is mounted by a plurality of fasteners 120 (Fig. 5) to a collar 122 (Fig. 4) of the inlet end journal 90.

In a preferred embodiment, the drive 106 is an electric motor that can be selectively controlled so as to vary its speed. The coupling arm 108 preferably is a tube that fixes the motor 106 to the gearbox 110 but which also couples the output shaft 124 of the motor 106 to an input (not shown) of the gearbox 110. The gearbox 110 preferably comprises a gear reducer or the like. The gearbox 110 is mounted by a bracket 126 that permits positioning adjustments to be made to the gearbox 110 and the like. The drive wheel 112 preferably is a sheave, a pulley, a sprocket, or the like and the endless flexible member 116 preferably is a belt, a cable, a chain or the like.

Referring additionally to Fig. 6, the product conveying arrangement 34 rotates during operation. In the preferred embodiment shown in the drawing figures, the product conveying arrangement 34 includes an auger 128 disposed inside a product processing chamber 130. The product processing chamber 130 preferably also rotates during operation, preferably in unison with the auger 128. In the preferred embodiment shown

in the drawing figures, the auger 128 consists of a plurality of pairs of axially, circumferentially and angularly spaced apart flights 132 that are each attached to an interior processing chamber surface 134. Each auger flight 132 preferably is attached to the interior processing chamber sidewall surface 134 using a plurality of fasteners (not shown) or the like that fix the flight 132 thereto. The auger flights 132 preferably are arranged in a generally helical pattern so as to forwardly urge product 136 in the processing chamber 130 through the chamber 130 during rotation.

The product processing chamber 130 has a body 138 that is of tubular construction with it being oriented such that its inlet end is located adjacent the inlet 38 of the rotary processing device 30 and its outlet end is located adjacent the outlet 42 of the device. Preferably, the chamber body 138 is of generally cylindrical and perforate construction. In one preferred embodiment, the chamber body 138 is comprised of a screen that preferably is a wedgewire screen or the like.

The conduit 68 is disposed above the product processing chamber 130 and is equipped with a plurality of pairs of longitudinally spaced apart discharge orifices 140 that each preferably comprises a discharge nozzle. The spaced apart nozzles 140 preferably extend substantially the full length of the processing chamber 130 to enable coverage therealong. One end of the conduit 68 is cradled in a notch 66 (Fig. 2) in the outlet end plate 46 and the other end is received in a mounting block 142 that is attached to the inlet end plate 50. A mounting bracket 144 that is attached to the outlet end plate 46 helps keep the conduit 68 captive to the end plate 46.

Fig. 6 illustrates a cross sectional view of the inlet tube 75. The inlet tube 75 has a sidewall 146 of generally cylindrical construction and a downwardly extending discharge plate 148 that defines a generally downwardly opening discharge outlet 150. During operation, product and the like entering the inlet tube 75 can impinge against the discharge plate 148 before falling downwardly into the product processing chamber 130.

Referring once again to Figs. 1 and 2, a hood 152 overlies the conduit 68, the auger 128, and the product processing chamber 130, and preferably abuts or adjoins both end plates 46 and 50. The hood 152 is of one-piece, unitary and homogenous construction and it includes a pair of spaced apart and integrally formed handles 154. The hood 152 has two halves 156, 158 with one hood half 156 being obtusely angled relative to the other hood half 158.

Referring to Fig. 7, the inlet tube 75 is generally coaxial with and received in the inlet end journal 90. As is shown in Fig. 7, the inlet tube 75 has a diameter that is less than the diameter of the inlet end journal 90 to permit the journal 90 to rotate relative to the tube 75.

The inlet end journal 90 preferably is generally cylindrical so as to facilitate rotation of the product processing chamber 130 to which it is coupled. In the preferred embodiment shown in Fig. 7, the journal 90 is attached at one axial end by fasteners 120 to driven wheel 118 and at its other axial end by fasteners 160 to an end cap 162 that is attached to an axial end of the body 138 of the product processing chamber 130. In one preferred embodiment, the end cap 162 is attached to an axial end of the body 138 of the

product processing chamber 130 by a plurality of pairs of fasteners (not shown). In another preferred embodiment, the end cap 162 is attached by a weld (not shown) to the processing chamber body 138.

The inlet end bearing arrangement 44 is a bearing ring 164 that encompasses the bore 92 in the inlet end plate 50 and that encircles the inlet end journal 90. Referring once again to Fig. 2, the annular bearing ring 164 is made up of an arcuately shaped upper bearing cradle 166 that overlies the journal 90 and an arcuately shaped lower bearing cradle 168 that underlies the journal 90. Each bearing cradle 166, 168 is attached to the inlet end plate 50 by a plurality of fasteners 170.

Referring additionally to Figs. 9-11, each bearing cradle 166 and 168 is of one-piece, unitary and homogeneous construction. Each bearing cradle 166, 168 preferably is of semicircular construction with integrally formed bolt hole pockets 167 equiangularly spaced about the cradle. Each bearing cradle 166 and 168 is made of a nonmetallic material. One preferred material is nylon. Another preferred material is ultra-high molecular weight polyethylene. Each bearing cradle preferably also is lubricant impregnated. Where the rotary processing device 30 is used for food processing applications, the lubricant preferably is a food grade lubricant that can be mineral oil based.

Each bearing cradle 166 and 168 has a pair of bearing surfaces 169 and 171 with one of the bearing surfaces 169 being a thrust bearing surface and the other one of the bearing surfaces 171 being a bearing surface that supports the inlet end journal 90.

During operation, collar 122 and/or driven wheel 118 bear against the thrust bearing surface 169.

During operation, the inlet end journal 90 bears against the rotary bearing surface 171. As is shown more clearly in Fig. 11, the rotary bearing surface 171 has a curvilinear outer profile that preferably is spherical or elliptical. Such a curvilinear bearing surface advantageously wears uniformly and provides increased bearing surface area contact as wear occurs. This helps increase bearing life while also being capable of handling widely varying bearing loads.

When wear of the bottom portion of the bearing surface 171 of the lower bearing cradle 168 becomes too great, the bearing mounting arrangement permits the lower bearing cradle 168 to be switched with the upper bearing cradle 166 to provide a less worn bearing surface 171. As a result, bearing life is advantageously further improved.

Referring to Fig. 8, the outlet end journal 64 is attached to the body 138 of the product processing chamber 130, preferably using fasteners, one or more welds, or the like. The outlet end journal 64 is ringed by an annular bearing arrangement that preferably is a bearing ring 172 of one-piece, unitary and homogenous construction. The bearing ring 172 is attached to the outlet end plate 46 by a plurality of pairs of fasteners 174 that are circumferentially spaced about the ring 172.

Referring additionally to Figs. 12-14, the bearing ring 172 is made of a nonmetallic material. One preferred material is nylon. Another preferred material is ultra-high molecular weight polyethylene. The bearing ring preferably also is lubricant

impregnated. Where the rotary processing device 30 is used for food processing applications, the lubricant preferably is a food grade lubricant that can be mineral oil based.

The bearing ring 172 preferably is circular in shape. The inner peripheral surface 176 of the bearing ring 172 is a bearing surface that rotatively supports the outlet end journal 64. The bearing ring 172 has a plurality of pairs of equiangularly spaced apart bolt hole pockets 178. When wear of the bottom of the bearing surface 176 becomes too great, this an arrangement permits the bearing ring 172 to be removed and rotated to move the worn portion of the bearing surface 176 away from the bottom, thereby moving a less worn portion of the bearing surface 176 to the bottommost position.

During operation, the outlet end journal 64 bears against the rotary bearing surface 176. As is shown more clearly in Fig. 14, the rotary bearing surface 176 has a curvilinear outer profile that preferably is spherical or elliptical. Such a curvilinear bearing surface advantageously wears uniformly and provides increased bearing surface area contact as wear occurs. This helps increase bearing life while also being capable of handling widely varying bearing loads.

In use, a rotary processing device 30 of the invention is well suited, for example, for processing food product, classifying applications, sieve and screen applications, and grading and sorting applications. In one preferred embodiment, a rotary processing device 30 fabricated in accordance with the invention is well suited for use as a reclaim screen. In another preferred embodiment, a rotary processing device 30 fabricated in

accordance with the invention is well suited for use as a grader or classifier. In a still further preferred embodiment, a rotary processing device 30 fabricated in accordance with the invention is well suited for use as a blancher, cooker or cooler.

When configured as a reclaim screen, the rotary processing device 30 is configured as depicted in the drawing figures. During operation, waste product 136 to be processed passes through the inlet tube 75 where it enters the product processing chamber 130. Auger rotation urges the waste product 136 from adjacent the inlet end of the product processing chamber 130 toward the outlet end. As the waste product 136 travels along the chamber 130, matter, primarily water, falls through the perforations in the chamber body 138 into a collector (not shown) below a bottom opening 180 (Fig. 6) created between the frame sidewalls 52, 54. Waste product 136 exiting the outlet is gathered in a separate collector (not shown) where it preferably awaits disposal. During operation, liquid preferably is expelled from the discharge nozzles 140 of the conduit 68 to keep waste product 136 from plugging perforations in the chamber body 138 and to dislodge waste product 136 that is plugging such perforations.

When configured as a grader or classifier, product 136 entering the processing chamber 130 is graded or classified according to the size of the perforations in the chamber body 138. Product 136 sized about the same or smaller than perforations in the chamber body 138 falls through the perforations into a collector (not shown) below the body 138. Larger product 136 travels along the length of the chamber 130 where it is expelled out the outlet.

When configured as a blancher, cooker or cooler, the sidewalls 52, 54 are joined or configured to form a sidewall of one-piece and unitary construction that forms a fluid-holding tank that underlies and encompasses at least part of the product processing chamber 130. The fluid-holding tank preferably holds a liquid, preferably water, which is used in the processing of product 136 as it travels along the product processing chamber 130. The product 136 preferably is a food product, such as pasta, beans, peas, corn, syrup, sauce, and the like. If desired, the product 136 being processed can be pouched food product.

It is understood that the various preferred embodiments are shown and described above to illustrate different possible features of the invention and the varying ways in which these features may be combined. Apart from combining the different features of the above embodiments in varying ways, other modifications are also considered to be within the scope of the invention.

The invention is not intended to be limited to the preferred embodiments described above, but rather is intended to be limited only by the claims set out below. Thus, the invention encompasses all alternate embodiments that fall literally or equivalently within the scope of these claims.